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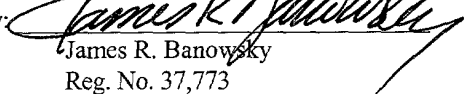
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1. Specification—title page, plus 60 pages, including 47 claims and Abstract
2. Transmittal letter including Certificate of Express Mailing
3. 7 Sheets Formal Drawings (Figs. 1-7)
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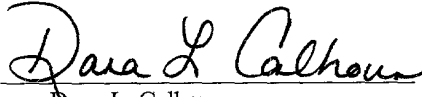
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR LETTERS PATENT

**Event Routing Model For An Extensible Editor**

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ATTORNEY'S DOCKET NO. MS1-657US

## **TECHNICAL FIELD**

The systems and methods described herein relate to extensible editors and, more particularly, the described implementations relate to event routing in extensible editors.

## **BACKGROUND**

The process of editing electronic documents generally consists of processing events and key combinations received by an editor. From events and key combinations, an editing space is created. The editing space consists of a document state plus a view state (visual feedback). The view state includes a selection state (what is selected, what is shown as feedback), scroll position, etc. The event interacts with the current state, and an editing model is applied to manipulate feedback or to manipulate the document based on the feedback.

Extensible editors typically provide a set of document manipulation services that can enable macros to perform advanced tasks on the content of a document. With an extensible editor, developers can integrate extensions that define or re-define a manner in which the editor responds to events or key combinations and provides visual feedback to a user. For example, if a developer wishes to create a new look to a selection process or a highlighting process in an extensible editor, the developer can create an extension that receives input regarding cursor position, cursor movement, mouse actions, etc. The developer can design the extension to use this input to create visual feedback that differs from default selection services or highlight services of the editor. However, familiar behavior of the editor (such as clicking a “bold” button) is still retained by

1 the editor. In addition, an extension can also expose virtually any kind of  
2 functionality through its own interfaces.

3 Extensible editors are designed so that one or more extensions can be  
4 coupled with the editor. This is accomplished by implementing a set of interfaces  
5 to which the extensions must conform. The interfaces are utilized by the  
6 extensions to access a host of basic functions so that the extensions themselves are  
7 not required to implement such basic functions. The extensions instead utilize the  
8 basic functions to perform tasks that supplement or override functions performed  
9 by the editor.

10 When utilizing extensions in an extensible editor, however, a conflict  
11 problem can arise if multiple extensions are used simultaneously that act upon the  
12 occurrence of the same event or key combination. If a first extension reacts to an  
13 event in one way, but a second extension receives the event after the first extension  
14 has acted on it, the second extension may also act on the event and, as a result,  
15 override the action of the first extension. This problem can occur even when using  
16 only one extension, if the extension acts on an event or key combination but does  
17 not prevent the (default) editor from subsequently acting on the same event.

## 18 SUMMARY

19 An extensible editor for editing electronic documents and/or content is  
20 described herein. The extensible editor provides an event routing model that  
21 improves avoidance of extension-extension and editor-extension event handling  
22 conflicts. The extensible editor ("editor") includes three sets of interfaces for  
23 extension integration.  
24  
25

1 The first set of interfaces is part of a designer extensibility mechanism. The  
2 designer extensibility mechanism is used to couple an extension (also called a  
3 “designer”) to the editor so the extension can utilize the event routing model of the  
4 editor. The designer extensibility mechanism provides the ability to connect an  
5 editor extension that can modify editing behavior. An attached designer receives  
6 events and key combinations in a predefined order and uses the set of interfaces to  
7 create custom editing extensions.

8 The designer extensibility mechanism includes an edit designer interface  
9 that has four methods: translate accelerator, pre-handle event, post-handle event  
10 and post-event notify. The methods act as callback routines whenever an event  
11 occurs in the editing environment of the editor. When an event comes into the  
12 editor, the four methods intercept the event at different points of the editor’s event  
13 handling process. The editor invokes the methods sequentially. If multiple  
14 designers are utilized, the editor invokes the current method on each designer  
15 sequentially, in the order in which the designers were registered with the editor.

16 If a designer acts on an event and wants to prevent any subsequent designer  
17 (or the editor) from acting on the event, the designer “consumes” the event by  
18 returning an appropriate signal to the editor. The designer returns a different  
19 signal when subsequent processing is to continue on an event.

20 Key combinations entered through a keyboard (e.g., Ctrl-A, Alt-P, etc.) first  
21 pass through the “translate accelerator” method. This is done in the order that the  
22 designers were added to the editor. If an event is generated by keyboard input  
23 (i.e., a key combination was entered), then the designer acts upon the event and  
24 “consumes” the event so that subsequent designers or the default editor cannot  
25 subsequently act upon the event.

1 The post-editor event notify method is an exception to the rule that  
2 consumed events are not passed on to subsequent designers or the editor for  
3 further processing. This method is always called on all designers, regardless of  
4 whether, or when, an event is consumed. This allows each designer to clean up  
5 any internal states that may be anticipating an event that is consumed before  
6 reaching the designer.

7 The second set of interfaces is included in a selection services component  
8 of the editor. The selection services component provides designers (*i.e.*, editing  
9 extensions) with the ability to manage logical selections that are used by  
10 commands and other extensions, *i.e.*, the ability to modify the logical selection  
11 state of the editor. As a result, all editing commands and services will be able to  
12 interact with a custom selection model without having detailed knowledge of the  
13 designer that is implementing the selection.

14 The third set of interfaces is included in a highlight rendering services  
15 component. The highlight rendering component allows a user to modify the  
16 rendered character attributes of text without modifying the document content.  
17 This facility is critical for providing a mechanism for providing user feedback  
18 without affecting persistence, undo, etc.

## **BRIEF DESCRIPTION OF THE DRAWINGS**

A more complete understanding of exemplary methods and arrangements of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings wherein:

Fig. 1 is an exemplary computer system on which the present invention may be implemented.

Fig. 2 is a block diagram of a computer having an extensible editor and several extensions coupled with the editor stored in memory.

Fig. 3 is a block diagram of an editor including a designer interface.

Fig. 4 is a block diagram of an event routing model utilized in an extensible editor.

Fig. 5 is a flow diagram of an event routing model for use in an extensible editor.

Fig. 6 is a block diagram of an editor including a selection services interface.

Fig. 7 is a block diagram of an editor including a highlighting services interface.

## **DETAILED DESCRIPTION**

The invention is illustrated in the drawings as being implemented in a suitable computing environment. Although not required, the invention will be described in the general context of computer-executable instructions, such as program modules, to be executed by a computing device, such as a personal computer or a hand-held computer or electronic device. Generally, program modules include routines, programs, objects, components, data structures, etc. that perform particular tasks or implement particular abstract data types. Moreover, those skilled in the art will appreciate that the invention may be practiced with other computer system configurations, including multi-processor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, and the like. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in both local and remote memory storage devices.

### **Exemplary Computer Environment**

The various components and functionality described herein are implemented with a number of individual computers. Fig. 1 shows components of typical example of such a computer, referred by to reference numeral 100. The components shown in Fig. 1 are only examples, and are not intended to suggest any limitation as to the scope of the functionality of the invention; the invention is not necessarily dependent on the features shown in Fig. 1.



1 Generally, various different general purpose or special purpose computing  
2 system configurations can be used. Examples of well known computing systems,  
3 environments, and/or configurations that may be suitable for use with the  
4 invention include, but are not limited to, personal computers, server computers,  
5 hand-held or laptop devices, multiprocessor systems, microprocessor-based  
6 systems, set top boxes, programmable consumer electronics, network PCs,  
7 minicomputers, mainframe computers, distributed computing environments that  
8 include any of the above systems or devices, and the like.

9 The functionality of the computers is embodied in many cases by  
10 computer-executable instructions, such as program modules, that are executed by  
11 the computers. Generally, program modules include routines, programs, objects,  
12 components, data structures, etc. that perform particular tasks or implement  
13 particular abstract data types. Tasks might also be performed by remote  
14 processing devices that are linked through a communications network. In a  
15 distributed computing environment, program modules may be located in both local  
16 and remote computer storage media.

17 The instructions and/or program modules are stored at different times in the  
18 various computer-readable media that are either part of the computer or that can be  
19 read by the computer. Programs are typically distributed, for example, on floppy  
20 disks, CD-ROMs, DVD, or some form of communication media such as a  
21 modulated signal. From there, they are installed or loaded into the secondary  
22 memory of a computer. At execution, they are loaded at least partially into the  
23 computer's primary electronic memory. The invention described herein includes  
24 these and other various types of computer-readable media when such media  
25 contain instructions programs, and/or modules for implementing the steps

1 described below in conjunction with a microprocessor or other data processors.  
2 The invention also includes the computer itself when programmed according to  
3 the methods and techniques described below.

4 For purposes of illustration, programs and other executable program  
5 components such as the operating system are illustrated herein as discrete blocks,  
6 although it is recognized that such programs and components reside at various  
7 times in different storage components of the computer, and are executed by the  
8 data processor(s) of the computer.

9 With reference to Fig. 1, the components of computer 100 may include, but  
10 are not limited to, a processing unit 120, a system memory 130, and a system bus  
11 121 that couples various system components including the system memory to the  
12 processing unit 120. The system bus 121 may be any of several types of bus  
13 structures including a memory bus or memory controller, a peripheral bus, and a  
14 local bus using any of a variety of bus architectures. By way of example, and not  
15 limitation, such architectures include Industry Standard Architecture (ISA) bus,  
16 Micro Channel Architecture (MCA) bus, Enhanced ISA (EISAA) bus, Video  
17 Electronics Standards Association (VESA) local bus, and Peripheral Component  
18 Interconnect (PCI) bus also known as the Mezzanine bus.

19 Computer 100 typically includes a variety of computer-readable media.  
20 Computer-readable media can be any available media that can be accessed by  
21 computer 100 and includes both volatile and nonvolatile media, removable and  
22 non-removable media. By way of example, and not limitation, computer-readable  
23 media may comprise computer storage media and communication media.  
24 "Computer storage media" includes both volatile and nonvolatile, removable and  
25 non-removable media implemented in any method or technology for storage of

1 information such as computer-readable instructions, data structures, program  
2 modules, or other data. Computer storage media includes, but is not limited to,  
3 RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM,  
4 digital versatile disks (DVD) or other optical disk storage, magnetic cassettes,  
5 magnetic tape, magnetic disk storage or other magnetic storage devices, or any  
6 other medium which can be used to store the desired information and which can be  
7 accessed by computer 110. Communication media typically embodies computer-  
8 readable instructions, data structures, program modules or other data in a  
9 modulated data signal such as a carrier wave or other transport mechanism and  
10 includes any information delivery media. The term "modulated data signal"  
11 means a signal that has one or more of its characteristics set or changed in such a  
12 manner as to encode information in the signal. By way of example, and not  
13 limitation, communication media includes wired media such as a wired network or  
14 direct-wired connection and wireless media such as acoustic, RF, infrared and  
15 other wireless media. Combinations of any of the above should also be included  
16 within the scope of computer readable media.

17 The system memory 130 includes computer storage media in the form of  
18 volatile and/or nonvolatile memory such as read only memory (ROM) 131 and  
19 random access memory (RAM) 132. A basic input/output system 133 (BIOS),  
20 containing the basic routines that help to transfer information between elements  
21 within computer 100, such as during start-up, is typically stored in ROM 131.  
22 RAM 132 typically contains data and/or program modules that are immediately  
23 accessible to and/or presently being operated on by processing unit 120. By way  
24 of example, and not limitation, Fig. 1 illustrates operating system 134, application  
25 programs 135, other program modules 136, and program data 137.

1       The computer 100 may also include other removable/non-removable,  
2 volatile/nonvolatile computer storage media. By way of example only, Fig. 1  
3 illustrates a hard disk drive 141 that reads from or writes to non-removable,  
4 nonvolatile magnetic media, a magnetic disk drive 151 that reads from or writes to  
5 a removable, nonvolatile magnetic disk 152, and an optical disk drive 155 that  
6 reads from or writes to a removable, nonvolatile optical disk 156 such as a CD  
7 ROM or other optical media. Other removable/non-removable,  
8 volatile/nonvolatile computer storage media that can be used in the exemplary  
9 operating environment include, but are not limited to, magnetic tape cassettes,  
10 flash memory cards, digital versatile disks, digital video tape, solid state RAM,  
11 solid state ROM, and the like. The hard disk drive 141 is typically connected to  
12 the system bus 121 through an non-removable memory interface such as interface  
13 140, and magnetic disk drive 151 and optical disk drive 155 are typically  
14 connected to the system bus 121 by a removable memory interface such as  
15 interface 150.

16       The drives and their associated computer storage media discussed above  
17 and illustrated in Fig. 1 provide storage of computer-readable instructions, data  
18 structures, program modules, and other data for computer 100. In Fig. 1, for  
19 example, hard disk drive 141 is illustrated as storing operating system 144,  
20 application programs 145, other program modules 146, and program data 147.  
21 Note that these components can either be the same as or different from operating  
22 system 134, application programs 135, other program modules 136, and program  
23 data 137. Operating system 144, application programs 145, other program  
24 modules 146, and program data 147 are given different numbers here to illustrate  
25 that, at a minimum, they are different copies. A user may enter commands and

1 information into the computer 100 through input devices such as a keyboard 162  
2 and pointing device 161, commonly referred to as a mouse, trackball, or touch  
3 pad. Other input devices (not shown) may include a microphone, joystick, game  
4 pad, satellite dish, scanner, or the like. These and other input devices are often  
5 connected to the processing unit 120 through a user input interface 160 that is  
6 coupled to the system bus, but may be connected by other interface and bus  
7 structures, such as a parallel port, game port, or a universal serial bus (USB). A  
8 monitor 191 or other type of display device is also connected to the system bus  
9 121 via an interface, such as a video interface 190. In addition to the monitor,  
10 computers may also include other peripheral output devices such as speakers 197  
11 and printer 196, which may be connected through an output peripheral interface  
12 195.

13 The computer may operate in a networked environment using logical  
14 connections to one or more remote computers, such as a remote computer 180.  
15 The remote computer 180 may be a personal computer, a server, a router, a  
16 network PC, a peer device or other common network node, and typically includes  
17 many or all of the elements described above relative to computer 100, although  
18 only a memory storage device 181 has been illustrated in Fig. 1. The logical  
19 connections depicted in Fig. 1 include a local area network (LAN) 171 and a wide  
20 area network (WAN) 173, but may also include other networks. Such networking  
21 environments are commonplace in offices, enterprise-wide computer networks,  
22 intranets, and the Internet.

23 When used in a LAN networking environment, the computer 100 is  
24 connected to the LAN 171 through a network interface or adapter 170. When used  
25 in a WAN networking environment, the computer 100 typically includes a modem

1 172 or other means for establishing communications over the WAN 173, such as  
2 the Internet. The modem 172, which may be internal or external, may be  
3 connected to the system bus 121 via the user input interface 160, or other  
4 appropriate mechanism. In a networked environment, program modules depicted  
5 relative to the computer 100, or portions thereof, may be stored in the remote  
6 memory storage device. By way of example, and not limitation, Fig. 1 illustrates  
7 remote application programs 185 as residing on memory device 181. It will be  
8 appreciated that the network connections shown are exemplary and other means of  
9 establishing a communications link between the computers may be used.

10 Fig. 2 is a block diagram of a computer 200 having a processor 202 and  
11 memory 204. An extensible editor 206 stored in the memory 204 includes an  
12 event routing controller 208, a designer extensibility mechanism 210, a selection  
13 services component 212, and a highlight rendering services component 214.  
14 Three designers 216, 218, 220 are also stored in the memory 204. Each of the  
15 designers 216 - 220 communicates with the editor 206 via the designer  
16 extensibility mechanism 210. Each designer 216 - 220, as shown, also  
17 communicates with the selection services component 212 and the highlight  
18 rendering component 214. It is noted, however, that a designer 216 - 220 may  
19 communicate with only the selection services component 212 or the highlight  
20 rendering component 214 or with neither. However, as will become clear in the  
21 following discussion, each designer 216 - 220 must attach to the editor 206  
22 through the designer extensibility mechanism 210.

23 A designer is an editor extension that is used to extend the functionality of  
24 the editor 206 and to customize the behavior of the editor 206. While the term  
25 "extension" is a generic term for a designer, the term "designer" is utilized in

1 several products of the MICROSOFT CORP., such as INTERNET EXPLORER  
2 5.5, MSHTML (the HTML parsing and rendering engine of INTERNET  
3 EXPLORER that displays a document with editable content), the WebBrowser  
4 (ActiveX) control, etc. For purposes of the present discussion, terms specific to  
5 one or more of such products will be used. For example, in the present discussion,  
6 editor extensions will be referred to as designers. A reference to such a specific  
7 term (*e.g.*, designer) is intended to include reference to the more generic term  
8 (*e.g.*, extension).

9 The designers 216 - 220 work by intercepting events and commands  
10 occurring in, or received by, the editor 206. When one or more of the designers  
11 216 - 220 intercepts an event, the designer can change how the editor 206 handles  
12 the event. Generally, a designer is written to either supplement or override the  
13 editor's behavior. Several designers may be attached to the editor 206 at once,  
14 thereby dynamically enabling multiple levels of custom functionality.

15 Designers offer a very powerful tool for customizing the editor 206.  
16 Virtually any part of the editor's behavior can be changed. For example, designers  
17 may be used to add spell checking capability to the editor 206, to add table editing  
18 functionality, to add annotation or revision-tracking capability, and so on. It is  
19 noted that, although only three designers 216 - 220 are shown in conjunction with  
20 the editor 206, any number of designers may be connected to the editor 206.

21 The designer extensibility mechanism 210, the selection services  
22 component 212, and the highlight rendering services 214 of the editor 206 shown  
23 in Fig. 2 provide specific functionality to the editor 206. Each of the modules and  
24 the functionality it provides will be discussed separately, in detail, below.  
25

## **Designer Extensibility Mechanism**

Fig. 3 is a block diagram of an editor 300 similar to the editor 206 shown in Fig. 2. The editor 300 includes a default event handler 301, an event routing controller 302 and a designer registry 303. The editor also includes an edit designer interface 304 that has several methods through which one or more designers (not shown) communicate with the editor 300. Each designer that is coupled with the editor 300 communicates with the editor 300 through the edit designer interface 304. Any coupled designer may then communicate with any other interfaces that are a part of the editor 300.

When a designer is added to the editor 300, the designer is registered in the designer registry 303. The event routing controller 302 accesses the designer registry 303 to determine the designers that are coupled with the editor 300. As will be discussed in greater detail below, the event routing controller 302 utilizes the designer registry 303 when routing events to attached designers.

The methods of the edit designer interface 304 are a translate accelerator method 306 (TranslateAccelerator), a pre-handle event method 308 (PreHandleEvent), a post-handle event method 310 (PostHandleEvent), and a post-editor event notify method 312 (PostEditorEventNotify). Each method 306 - 312 has two parameters, an event identifier 314 and an event object interface 316. In one implementation, the event identifier 314 is a value included in HTMLELEMENTEVENTS2 in mshtmdid.h, and the event object interface 316 is an IHTMLEventObj, which enables a designer to obtain more extended information about the event.

The methods 306 - 312 act as callback routines whenever an event occurs in the editing environment. In other words, whenever an event occurs that is



1 detected by the editor 300, each of the methods 306 - 312 is called, in a particular  
2 sequence, by the editor 300 to process the event. Processing the event may entail  
3 providing an external response to the event, responding internally to the event, not  
4 responding to the event, consuming the event and/or passing the event for further  
5 processing (*i.e.*, not consuming the event).

6 The event routing controller 302 determines when a particular method will  
7 be called. If multiple designers are registered with the editor 300 in the designer  
8 registry 303, the event routing controller 302 invokes the current method on each  
9 designer sequentially, in the order in which the designers were registered with the  
10 editor 300. Further explanation of the event routing technique will be explained  
11 below with continuing reference to the elements and reference numerals of Fig. 3.

12 Fig. 4 is a block diagram of an event routing model utilized in an extensible  
13 editor. In addition to the editor 300 shown in Fig. 3, Fig. 4 includes a first  
14 extension, Designer A 320, and a second extension, Designer B 330. Although  
15 only two designers 320, 330 are shown, it should be understood that virtually any  
16 number of designers may be added to the editor 300. The functionality of the  
17 routing mechanism when using more than two designers is similar to the  
18 description of the routing mechanism using the two designers 320, 330.

19 The editor 300 is designed to receive notification of an event 400. If the  
20 event 400 is a key combination input by a user, then the event routing controller  
21 302 routes the event to the translate accelerator method 306. The event 400 is  
22 made available to a translation accelerator 306a in Designer A 320. The  
23 translation accelerator 306a of Designer A 320 may or may not provide a response  
24 to the event 400. If a response is provided to the event 400 by Designer A 320,  
25 then Designer A 320 may consume the event 400 to prevent Designer B 330 from

1 overriding the response to the event 400 by Designer A 320. To “consume” an  
2 event, a designer returns a value (S\_OK) to the editor indicating that no further  
3 processing should be done on the event. If Designer A 320 does not respond to  
4 the event 400, then the event 400 will be made available to a translation  
5 accelerator 306b of Designer B 330. To indicate that an event should continue to  
6 be processed, a designer returns a different value to the editor (S\_FALSE).  
7 Designer B 330 may then respond or not respond to the event 400 in the same way  
8 as described for Designer A 320. This process continues with any other designers  
9 that may be attached to the editor 300.

10 After each designer 320, 330 has had the opportunity to react to the event  
11 400 (unless one of the designers 320, 330 has already consumed the event),  
12 control of the event 400 is returned to the event routing controller 302 of the editor  
13 300. It is noted that the editor 300 may include its own translate accelerator that  
14 is designed to translate the key combination. This translate accelerator could be a  
15 part of the default event handler 301. In the preferred implementation, the default  
16 event handler 301 will receive the key combination (event 400) if not already  
17 consumed by one of the designers 320, 330. The default event handler 301 may or  
18 may not be configured to provide a response to the particular key combination. If  
19 it is configured to respond to a particular key combination, then an appropriate  
20 response is made; if not, then no response will be made to the key combination.

21 It is significant that if Designer B 330 is configured to act on a particular  
22 key combination, Designer B 330 may never receive that key combination if  
23 Designer A 320 consumes the combination. Therefore, it is noted that while the  
24 implementations described herein significantly improve conflict avoidance in  
25 extensible editors, when developing a new designer, careful consideration must be

1 given to the key combinations and events that will trigger actions by a designer.  
2 Also, multiple designers can be strategically registered with the editor 300 to  
3 avoid this situation.

4 If the event 400 is not a key combination, then the event routing controller  
5 makes the event 400 available to the designers 320, 330 via the pre-handle event  
6 method 308. Designer A 320 first has the opportunity to respond to the event 400.  
7 If Designer A 320 is configured to respond to the event 400, then it provides an  
8 appropriate response. After providing a response, Designer A 320 may either  
9 consume the event 400 or pass it along.

10 If, for example, Designer A 320 is an "auto correct" designer and Designer  
11 B 330 is a grammar checking designer, an event (entry of a word into the  
12 document) would be routed first through the auto correct designer to determine if  
13 the word should be corrected. After the word is checked (whether or not it is  
14 corrected), the grammar checking designer still requires notice of the event to  
15 perform its function. Therefore, Designer A 320 would act on the event but still  
16 make it available to Designer B 330

17 If the event 400 is not consumed by Designer A 320, then the event 400 is  
18 made available to Designer B 330. Designer B 330 has the same options of  
19 reacting to the event 400 as described above for Designer A 320. This is true for  
20 each subsequent designer attached to the editor 300.

21 After each designer has the opportunity to respond to the event 400 a first  
22 time, the event is passed to the default event handler 301 (assuming that the event  
23 400 has not been previously consumed by a designer). The default event handler  
24 301 then provides the default behavior of the editor 300 in response to the event  
25 400. It is noted that if no designers are attached to the editor 300, then the editor

1 300 will simply provide the default editing behavior via the default event handler  
2 301.

3 After the default event handler 301 has acted on the event 400, the  
4 designers 320, 330 are provided another opportunity to respond to the event 400.  
5 The event 400 is made available to the designers 320, 330 through the post-handle  
6 event method 310. The post-handle event processing is similar to the pre-handle  
7 event processing, occurring in the sequence in which the designers 320, 330 were  
8 registered with the editor 300.

9 By way of example, suppose that a developer wants to implement an “auto  
10 correct” designer that listens to key strokes. The designer, in this case, should  
11 receive an event after a typed character is inserted into the document (*i.e.*,  
12 PostHandleEvent) rather than before the character is inserted. Receiving the event  
13 after the default editor has inserted the character allows the designer to inspect the  
14 document with the correct content, allow undo of auto-correct behavior, etc.

15 After the post-handle event processing is concluded, the event 400 is  
16 processed by the default handler 301.

17 The post-editor event notify method 312 is called after the editor 300 has  
18 finished its post-handling of the event 400 or when a designer 320, 330 has  
19 consumed the event. In the case where the event 400 is consumed by a designer  
20 320, 330 before a default action takes place and no post-handle event methods are  
21 called, a post-editor event notification module 312a, 312b is invoked to give the  
22 designers 320, 330 an opportunity to make a final response. For example, suppose  
23 a mouse down event starts a selection in a designer that implements basic text  
24 selection. If there is a mouse down event, the designer starts the selection. Now,  
25 if some other designer consumes the corresponding mouse up event, the designer

1 still needs to know about the mouse up event so it can terminate the selection and  
2 stop responding to mouse move events.

3 Fig. 5 is a flow diagram of the preferred implementation of the event  
4 routing model described above for use in an extensible editor 300. Continuing  
5 reference will be made to the elements and reference numerals of Fig. 2 – Fig. 4 in  
6 the description of the flow diagram.

7 At step 500, an event 400 is received by the editor 300. The event routing  
8 controller 302 determines if the event 400 is a key combination at step 502. If the  
9 event is a key combination (“Yes” branch, step 502), then the key combination is  
10 translated at step 504 by the designers (if they are configured to translate the  
11 particular command) or by the default event handler 301 if no designer translates  
12 the key combination and the editor 300 is configured to do so.

13 If the event is not a key combination (“No” branch, step 502) the editor 300  
14 determines if a designer 320, 330 is attached to the editor 300 at step 508. If there  
15 is not an attached designer (“No” branch, step 508), the event is processed by the  
16 default event handler 301 at step 510. If, however, a designer 320, 330 is attached  
17 to the editor 300 (“Yes” branch, step 508), then the event 400 is made available to  
18 Designer A 320 for pre-handling at step 512. After Designer A 320 has had the  
19 opportunity to act on the event 400, Designer B 330 (“Yes” branch, step 514) has  
20 the event 400 made available for processing at step 512. There is no other  
21 designer attached (“No” branch, step 514), so the event (if not previously  
22 consumed), is passed to the default event handler 301 and processed at step 516.

23 After the event 400 is processed by the default event handler 301 of the  
24 editor 300, the event is made available to Designer A 320 for processing at step  
25 518. Since there is another designer (Designer B 330) (“Yes” branch, step 520),

1 the event 400 is made available to Designer B 330 for processing at step 518.  
2 When there are no more designers to process the event 400 ("No" branch, step  
3 520), the event is processed by the default event handler 301 at step 522.

4 It is noted that the above discussion assumes that the event 400 is not  
5 consumed by the default event handler 301 or the designers 320, 330 and is  
6 processed by each method of the editor 300 and the designers 320, 330. Once an  
7 event is consumed, further processing of the event terminates.

8 After the event has been through the pre-handle event method 308 and the  
9 post-handle event method 310, the post-editor event notification method 312 is  
10 called (step 524). Unless consumed by the default event handler 310 or one of the  
11 designers 320, 330, each designer 320, 330 is notified of any response to the event  
12 400 from any other module as previously described.

### 13 **Designer Extensibility Mechanism Interfaces**

14 In addition to the edit designer interface 304 described above, the designer  
15 extensibility mechanism 210 includes an edit services interface. In MSHTML, the  
16 edit services interface - designated as IHTMLEditServices - is used to add or  
17 remove edit designers and control the current selection. Although the general  
18 descriptions of the designer extensibility mechanism can be applied and  
19 implemented in any extensible editor and extensions therefor, for discussion  
20 purposes, the described implementation will refer to MICROSOFT MSHTML  
21 terminology to describe interfaces exposed by a designer extensibility mechanism  
22 to allow extensions to be properly coupled to communicate with an extensible  
23 editor. Those skilled in the art will appreciate the functions enabled by the  
24 described interfaces to implement custom extensions for the extensible editor.  
25

1 The following are detailed descriptions of the edit designer interface and  
2 the edit services interface.

### 3 Edit Designer Interface (IHTMLEditDesigner)

4 The edit designer interface includes the following methods:

#### 5 **TranslateAccelerator**

6 Description: Called by MSHTML to translate a key combination entered  
7 by a user into an appropriate command.

8 Syntax:

9 HRESULT TranslateAccelerator (  
10 DISPID *inEvtDispId*,  
11 IHTMLEventObj \**pIEventObj*

12 Parameters:

13 *inEvtDispId*

14 [in] DISPID that specifies the event.

15 *pIEventObj*

16 [in] Pointer to an IHTMLEventObj interface that specifies the  
17 event.

18 Return Values:

19 Returns S\_OK to indicate that the event has been completely  
20 handled and that no further processing should take place, either by  
21 other edit designers or the MSHTML Editor. Returns S\_FALSE to  
22 indicate that other edit designers and the MSHTML Editor should  
23 perform their processing the this event.  
24  
25

## PreHandleEvent

Description: Called by MSHTML before the MSHTML Editor processes an event, so that the designer can provide its own event handling behavior.

Syntax:

```
HRESULT PreHandleEvent (  
    DISPID inEvtDispId,  
    IHTMLEventObj *pIEventObj
```

Parameters:

*inEvtDispId*

[in] DISPID that specifies the event.

*pIEventObj*

[in] Pointer to an IHTMLEventObj interface that specifies the event.

Return Values:

Returns S\_OK to indicate that the event has been completely handled and that no further processing should take place, either by other edit designers or the MSHTML Editor. Returns S\_FALSE to indicate that other edit designers and the MSHTML Editor should perform their pre-event processing.

## PostHandleEvent

Description: Called by MSHTML after the MSHTML Editor processes an event, so that the designer can provide its own event handling behavior.

Syntax:

```
HRESULT PostHandleEvent (  
    DISPID inEvtDispId,  
    IHTMLEventObj *pIEventObj
```



Parameters:

*inEvtDispId*

[in] DISPID that specifies the event.

*pIEventObj*

[in] Pointer to an IHTMLEventObj interface that specifies the event.

Return Values:

Returns S\_OK to indicate that the event has been completely handled and that no further processing should take place, either by other edit designers or the MSHTML Editor. Returns S\_FALSE to indicate that other edit designers and the MSHTML Editor should perform their post-event processing.

### **PostEditorEventNotify**

Description: Called by MSHTML after an event has been handled by the MSHTML Editor and any registered edit designers.

Syntax:

```
HRESULT PostHandleEvent (  
    DISPID inEvtDispId,  
    IHTMLEventObj *pIEventObj
```

Parameters:

*inEvtDispId*

[in] DISPID that specifies the event.

*pIEventObj*

[in] Pointer to an IHTMLEventObj interface that specifies the event.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

#### Edit Services Interface (IHTMLEditServices)

The edit designer interface includes the following methods:

##### **AddDesigner**

Description: Registers an IHTMLEditDesigner interface to receive event notification from the editor.

Syntax:

```
HRESULT AddDesigner (  
    IHTMLEditDesigner *pIDesigner  
);
```

Parameters:

*\*pIDesigner*

[in] Pointer to an IHTMLEditDesigner interface to register for event notification.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

##### **GetSelectionServices**

Description: Registers an IHTMLEditDesigner interface to receive event notification from the editor.

Syntax:

```
HRESULT GetSelectionServices (  
    IMarkupContainer *pIContainer
```

1                   ISelectionServices *\*\*ppSelSvc*

2                   );

3       Parameters:

4                   *\*pIContainer*

5                   [in] Pointer to an IMarkupContainer interface for which an  
6                   ISelectionServices interface is desired.

7                   *\*\*ppSelSvc*

8                   [out] Address of a pointer to a variable that receives an  
9                   ISelectionServices interface pointer for the ISelectionServices  
10                  interface on the editor's selection object.

11       Return Values:

12                  Returns S\_OK if successful, or an error value otherwise.

13       **MoveToSelectionAnchor**

14       Description: Moves a markup pointer to the location of an anchor for the  
15       current selection.

16       Syntax:

17                  HRESULT MoveSelectionToAnchor (  
18                          IMarkupPointer *\*pIStartAnchorr*  
19                  );

20       Parameters:

21                   *\*pIStartAnchor*

22                   [in] Pointer to an IMarkupPointer interface to move the  
23       location of an anchor for the selection.

24       Return Values:

25                  Returns S\_OK if successful, or an error value otherwise.

## **MoveToSelectionEnd**

Description: Moves markup pointer to the end of the current selection.

Syntax:

```
HRESULT MoveToSelectionEnd (  
    IMarkupPointer *pIEndAnchor  
);
```

Parameters:

*\*pIEndAnchor*

[in] Pointer to an IMarkupPointer interface to move to the end of the current session.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

## **RemoveDesigner**

Description: Unregisters a designer from the editor.

Syntax:

```
HRESULT RemoveDesigner (  
    IHTMLEditDesigner *pIDesigner  
);
```

Parameters:

*pIDesigner*

[in] Pointer to the IHTMLEditDesigner interface to remove from the event notification queue.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

## Selection Services

Selection services provides extensions a way to modify a selection process of an extensible editor to which the designers are coupled. Although the general descriptions of the selection services can be applied and implemented in any extensible editor and extensions therefor, for discussion purposes, the described implementation will refer to MICROSOFT MSHTML terminology to describe interfaces exposed by a selection services component to allow extensions to properly communicate with an extensible editor to utilize the selection services component. Those skilled in the art will appreciate the functions enabled by the described interfaces to implement custom extensions for the extensible editor.

Fig. 6 is a block diagram of an extensible editor 600 that includes a designer interface 602, an event routing mechanism 604, and a selection services component 606. The selection services component 606 includes several interfaces: a selection services interface 608 (ISelectionServices), a selection services listener interface 610 (ISelectionServiceListener), an element segment interface 612 (IElementSegment), a segment list interface 614 (ISegmentList), and a segment interface 616 (ISegment). These interfaces 608 – 616 will be discussed in greater detail, below.

The role of the selection services interfaces 608 – 616 is to provide designers or other editing extensions with the ability to modify the logical selection state. Consequently, all editing commands and services can interact with a custom selection model without having detailed knowledge of the designer that is implementing the selection.

For example, the “bold” command is able to implement the operation of making something bold without having any knowledge of the specifics of a given

1 designer. The command is only aware of what part of the document is selected,  
2 and it is configured to make the selected region of the document bold. A user still  
3 only has to know the click on a “bold” icon to invoke the “bold” command.

#### 4 Selection Service Interface (ISelectionServices)

5 The selection services interface 608 provides methods to programmatically  
6 clear, add and remove segments from a selection object. The methods include an  
7 add element segment method 618 (AddElementSegment), a get markup container  
8 method 620 (GetMarkupContainer), a get selection services listener method 622  
9 (GetSelectionServicesListener), an add segment method 624 (AddSegment), a  
10 remove segment method 626 (RemoveSegment), and a set selection type method  
11 628 (SetSelectionType). The following are detailed description of the available  
12 selection services interface 608 methods.

#### 13 **AddElementSegment**

14 Description: The add element segment method 618 creates an  
15 IElementSegment interface for an element in a markup container and adds the  
16 segment to the editable selection.

17 Syntax:

```
18 HRESULT AddElementSegment (  
19     IHTMLElement *pIElement,  
20     IElementSegment **ppISegmentAdded  
21 );
```

22 Parameters:

23 *\*pIElement*

24 [in] Pointer to an IHTMLElement interface that specifies the  
25 element to add to the selection.

1           ***\*\*ppISegmentAdded***

2                   [out] Address of a pointer to a variable that receives an  
3           IElementSegment interface pointer for the element segment  
4           added to the selection environment.

5   Return Values:

6           Returns S\_OK if successful, or an error value otherwise.

7   **GetMarkupContainer**

8   Description: The get markup container method 620 retrieves the markup  
9   container for the current editable selection.

10   Syntax:

11           HRESULT GetMarkupContainer (  
12                   IMarkupContainer ***\*\*ppIContainer***  
13           );

14   Parameters:

15           ***\*\*ppIContainer***

16                   [out] Address of a pointer to a variable that receives an  
17           IMarkupContainer interface pointer to the interface for the  
18           markup container that contains the current editable selection.

19   Return Values:

20           Returns S\_OK if successful, or an error value otherwise.

21   **GetSelectionServicesListener**

22   Description: The get selection services listener 622 method retrieves an  
23   ISelectionServicesListener interface for the current editable selection so that the  
24   editor can process certain selection events.

25   Syntax:

1 HRESULT GetSelectionServicesListener (

2 ISelectionServicesListener *\*\*ppISelectionServicesListener*

3 );

4 Parameters:

5 *\*\*ppISelectionServicesListener*

6 [out] Address of a pointer to a variable that receives an  
7 ISelectionServicesListener interface pointer to the interface  
8 that the editor will use with the current editable selection.

9 Return Values:

10 Returns S\_OK if successful, or an error value otherwise.

## 11 AddSegment

12 Description: The add segment method 624 creates an ISegment interface  
13 for the content between two markup pointers in a markup container, and adds the  
14 segment to the editable selection.

15 Syntax:

16 HRETURN AddSegment (

17 IMarkupPointer *\*pIStart*,

18 IMarkupPointer *\*pIEnd*,

19 ISegment *\*\*ppISegmentAdded*

20 );

21 Parameters:

22 *\*pIStart*

23 [in] Pointer to an IMarkupPointer interface that specifies the  
24 start point for adding the segment.

25 *\*pIEnd*



[in] Pointer to an IMarkupPointer interface that specifies the end point for adding the segment.

***\*\*ppISegmentAdded***

[out] Address of a pointer to a variable that receives an ISegment interface pointer to the interface for the added segment in the selection environment.

**Return Values:**

Returns S\_OK if successful, or an error value otherwise.

**RemoveSegment**

Description: The remove segment method 626 (RemoveSegment) removes a segment from the editable selection.

**Syntax:**

```
HRESULT RemoveSegment (  
    ISegment *pISegment  
);
```

**Parameters:**

***\*pISegment***

[in] Pointer to an ISegment interface that specifies the segment to remove.

**Return Values:**

Returns S\_OK if successful, or an error value otherwise.

**SetSelectionType**

Description: The set selection type method 628 (SetSelectionType) sets the selection type and clears any existing selection.

1 Syntax:

2 HRESULT SetSelectionType;  
3 SELECTION\_TYPE *eType*  
4 ISelectionServicesListener *\*pILListener*  
5 );

6 Parameters:

7 *eType*

8 [in] SELECTION\_TYPE enumeration that specifies the type  
9 of selection to set.

10 *\*pILListener*

11 [in] Optional. Pointer to an ISelectionServiceListener  
12 interface specifying the interface to associate with this  
13 selection. Set to NULL if unused. NOTE: Although this  
14 parameter is optional, without this parameter, the editor will  
15 not be able to restore the selection.

16 Return Values:

17 Returns S\_OK if successful, or an error value otherwise.

18  
19 Element Segment Interface (IElementSegment)

20 The element segment interface 610 provides methods that control a  
21 fragment of HTML markup in the current editable selections that consists of a  
22 single element. The element segment interface 612 includes a get element method  
23 630 (GetElement), an 'is primary' method 632 (IsPrimary), and a set primary  
24 method 634 (SetPrimary). To obtain an IElementSegment interface for a fragment  
25

1 of HTML markup representing an element, the  
2 ISelectionServices::AddElementSegment method is used.

3 The selection object uses element segments to mark fragments of HTML  
4 markup that are whole elements, in particular control elements.

### 5 **GetElement**

6 Description: The get element method 612 (GetElement) retrieves the  
7 element to which this segment refers.

8 Syntax:

```
9 HRESULT GetElement (  
10 IHTMLElement **ppIElement  
11 );
```

12 Parameters:

13 *\*\*ppIElement*

14 [out] Address of a pointer to a variable that receives an  
15 IHTMLElement interface pointer for the interface  
16 representing the element to which the segment refers.

17 Return Values:

18 Returns S\_OK if successful, or an error value otherwise.

### 19 **Is Primary**

20 Description: The is primary method 632 (IsPrimary) determines whether  
21 the control element represented by this segment is the primary element of a multi-  
22 element selection. The primary element of a multiple selection is typically the  
23 first one chosen by a user when a selection was made. The primary element  
24 typically has distinctive handles that indicate it is the primary element. For  
25

example, the primary element might have white handles while the other elements have black ones).

Syntax:

```
HRESULT IsPrimary (  
    BOOL *pfPrimary  
);
```

Parameters:

*\*pfPrimary*

[out] Pointer to a BOOL that receives TRUE if the element is the primary element, or FALSE otherwise.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

### **Set Primary**

Description: The set primary method (SetPrimary) sets or unsets a control element as a primary element in a control selection. The primary element of a multiple selection is typically the first one chosen by a user when a selection was made. The primary element typically has distinctive handles that indicate it is the primary element. For example, the primary element might have white handles while the other elements have black ones.

Syntax:

```
HRESULT SetPrimary  
    BOOL fPrimary  
);
```

Parameters:

*fPrimary*

[in] BOOL that specifies TRUE to set the element as the primary element, or FALSE to unset it as primary.

#### Return Values:

Returns S\_OK if successful, or an error value otherwise.

#### Segment Interface (ISegment)

The segment interface 616 provides a method that creates containers (segments) for fragments of HTML markup in the current editable selection. These segments can include both a range of elements and element fragments. The segment interface 616 includes a get pointers method 636 (GetPointers).

#### **GetPoiners**

Description: The get pointers method 636 (GetPointers) positions markup pointers at the start and end of the selection segment.

#### Syntax:

```
HRESULT GetPointers (  
    IMarkupPointer *pIStart,  
    IMarkupPointer *pIEnd  
);
```

#### Parameters:

*pIStart*

[in] Pointer to an IMarkupPointer interface that specifies the markup pointer to position at the beginning of the segment.

*pIEnd*

[in] Pointer to an IMarkupPointer interface that specifies the markup pointer to position at the end of the segment.

1 Return Values:

2 Returns S\_OK if successful, or an error value otherwise.

3  
4 Segment List Interface (ISegmentList)

5 The segment list interface 614 provides methods that access information  
6 about a list of the segments in the current selection. The segment list interface 614  
7 includes a create iterator method 638 (CreateIterator), a get type method 640  
8 (GetType), and an 'is empty' method 640 (IsEmpty).

9 **CreateIterator**

10 Description: The create iterator method 638 creates an  
11 ISegmentListIterator interface used for traversing the members of a segment list.

12 Syntax:

13 HRESULT CreateIterator (  
14 ISegmentListIterator \*\**ppIter*  
15 );

16 Parameters:

17 *ppIter*

18 [out] Address of a pointer to a variable that receives an  
19 ISegmentListIterator interface pointer for the newly created  
20 ISegmentListIterator.

21 Return Values:

22 Returns S\_OK if successful, or an error value otherwise.

23 **GetType**

24 Description: The get type method 640 retrieves the type of the selection.

25 Syntax:

1        HRESULT GetType (  
2                SELECTION\_TYPE \**peType*  
3        );

4        Parameters:

5                *peType*

6                [out] Pointer to a variable of type SELECTION\_TYPE that  
7                receives the selection type value.

8        Return Values:

9                Returns S\_OK if successful, or an error value otherwise.

10        **IsEmpty**

11        Description: The 'is empty' method 642 determines whether the segment  
12        list is empty.

13        Syntax:

14        HRESULT IsEmpty (  
15                BOOL \**pfEmpty*  
16        );

17        Parameters:

18                *pfEmpty*

19                [out] Pointer to a variable of type BOOL that receives TRUE  
20                if the segment list is empty, or FALSE if it is not empty.

21        Return Values:

22                Returns S\_OK if successful, or an error value otherwise.

## Selection Services Listener Interface (ISelectionServicesListener)

The selection services listener interface 610 provides methods that the editing component of MSHTML calls whenever certain events fire for a selection object that has a registered ISelectionServicesListener interface. This interface provides processing for undo events, for selection type changes, and whenever the mouse pointer exits the scope of an element in the editable selection. An application should supply an implementation of this interface for a selection object so that the editing component of MSHTML can respond to these events. The selection services listener interface 610 includes a begin selection undo method (BeginSelectionUndo) 644, an end selection undo method 646 (EndSelectionUndo), a get type detail method 648 (GetTypeDetail), an 'on change type' method 650 (OnChangeType), and an 'on selected element exit' method 652 (OnSelectedElementExit). To register an ISelectionServicesListener interface for a particular selection object, the ISelectionServices::SetSelectionType method or ISelectionServices::OnChangeType method is used.

### **BeginSelectionUndo**

**Description:** The begin selection undo method 644 is called by the editor 600 when an editing operation is beginning that may result in a change in selection after the editing operation. This method exists so that the designers may place their own units on an Undo queue so that a selection may be restored to its original state when the editing process was started.

### **Syntax:**

HRESULT BeginSelectionUndo (VOID);

### **Parameters:**

None.



1       Return Values:

2               Returns S\_OK if successful, or an error value otherwise.

3       **EndSelectionUndo**

4       Description: The end selection undo method 644 is called by the editor 600  
5 at the end of an editing operation that may result in a change in selection after the  
6 editing operation. This method exists so that the designers may place their own  
7 units on an Undo Queue so that a selection may be restored to its original state  
8 when the editing process was started.

9       Syntax:

10               HRESULT EndSelectionUndo (VOID);

11       Parameters:

12               None.

13       Return Values:

14               Returns S\_OK if successful, or an error value otherwise.

15       **GetTypeDetail**

16       Description: The get type detail method 648 is called by MSHTML to  
17 obtain the name of the selection type. This method allows a host application to  
18 provide the name of a selection type when implementing a custom selection  
19 mechanism. MSHTML will return a value of 'undefined' if the host does not  
20 implement this method.

21       Syntax:

22               HRESULT GetTypeDetail (  
23                       BSTR \*pTypeDetail  
24               );  
25

Parameters:

*pTypeDetail*

[out] BSTR that specifies the name of the selection type.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

## **OnChangeType**

Description: The 'on change type' method 650 is called by the editor 600 when the type of a selection changes. This method is used to implement custom processing that should take place when a selection is initiated or when a selection changes type.

Syntax:

```
HRESULT OnChangeType (  
    SELECTION_TYPE eType,  
    ISelectionServicesListener *pIListener  
);
```

Parameters:

*eType*

[in] SELECTION\_TYPE enumeration that specified the new selection type.

*pIListener*

[in] Optional. Pointer to an ISelectionServicesListener interface to register with the new selection. Can be set to NULL.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

## OnSelectedElementExit

Description: The 'on selected element' exit method 652 is called by the editor 600 whenever an element that intersects selection undo is removed from the document. This method exists so that the selection can be updated by the extensible editor (either removed or adjusted).

### Syntax:

```
HRESULT OnSelectedElementExit (  
    IMarkupPointer *pIElementStart,  
    IMarkupPointer *pIElementEnd,  
    IMarkupPointer *pIElementContentStart,  
    IMarkupPointer *pIElementContentEnd  
);
```

### Parameters:

*\*pIElementStart*

[in] Pointer to an IMarkupPointer interface specifying the point just before the element's opening tag.

*\*pIElementEnd*

[in] Pointer to an IMarkupPointer interface specifying the point just after the element's closing tag.

*\*pIElementContentStart*

[in] Pointer to an IMarkupPointer interface specifying the point just after the element's opening tag.

*\*pIElementContentEnd*

[in] Pointer to an IMarkupPointer interface specifying the point just before the element's closing tag.

1       Return Values:

2               Returns S\_OK if successful, or an error value otherwise.

### 3 4       **Highlight Rendering Services**

5       Highlight rendering services allows a user to modify the rendered character  
6 attributes of text without modifying the document content. This facility is critical  
7 for providing a mechanism for providing user feedback without modifying the  
8 document content. This component is critical for providing a mechanism for  
9 providing user feedback without affecting persistence, undo, etc.

10       Fig. 7 is a block diagram of an extensible editor 700 that includes a  
11 designer interface 702, an event routing mechanism 704, and a highlight rendering  
12 services component 706. The highlight rendering services component 706  
13 includes two interfaces: a highlight services interface 708  
14 (IHighlightRenderingServices), and a highlight segment interface 710  
15 (IHighlightSegment). These interfaces 708, 710 will be discussed in greater detail,  
16 below.

### 17       **Highlight Rendering Services Interface (IHighlightRenderingServices)**

18       The highlight rendering services interface 708 provides methods that enable  
19 a designer to control which sections of a document are highlighted on the screen  
20 and the style of highlighting. The methods include an add segment method 712  
21 (AddSegment), a move segment to pointers method 714  
22 (MoveSegmentToPointers), and a remove segment method 716  
23 (RemoveSegment). The following are detailed description of the available  
24 selection services interface 608 methods.

## AddSegment

Description: The add segment method 712 creates a highlight segment for the markup between two display pointers and highlights it according to a specified rendering style.

Syntax:

```
HRESULT AddSegment (  
    IDisplayPointer *pDispPointerStart,  
    IDisplayPointer *pDispPointerEnd,  
    IHTMLRenderStyle *pIRenderStyle,  
    IHighlightSegment **ppISegment  
);
```

Parameters:

*pDispPointerStart*

[in] Pointer to an IDisplayPointer interface representing the start point of the segment to be highlighted.

*pDispPointerEnd*

[in] Pointer to an IDisplayPointer interface representing the end point of the segment to be highlighted.

*pIRenderStyle*

[in] Pointer to an IHTMLRenderStyle interface representing the style with which to render the specified segment.

*ppISegment*

[out] Address of a pointer to a variable that receives an IHighlightSegment interface pointer for the interface that

represents the highlight segment between pDispPointerStart and pDispPointerEnd.

**Return Values:**

Returns S\_OK if successful, or an error value otherwise.

**MoveSegmentToPointers**

**Description:** The move segments to pointers method 714 redefines a highlight segment and its style.

**Syntax:**

```
HRESULT MoveSegmentToPointers (  
    IHighlightSegment *pISegment,  
    IDisplayPointer *pDispPointerStart,  
    IDisplayPointer *pDispPointerEnd  
);
```

**Parameters:**

*pISegment*

[in] Pointer to an IHighlightSegment interface to redefine.

*pIDispPointerStart*

p[in] Pointer to an IDisplayPointer interface for the new start point of the highlight segment.

*pIDispPointerEnd*

[in] Pointer to an IDisplayPointer interface for a new endpoint of the highlight segment.

**Return Values:**

Returns S\_OK if successful, or an error value otherwise.

## RemoveSegment

Description: The remove segment method 716 removes a highlight segment from a collection of segments that are highlighted.

Syntax:

```
HRESULT RemoveSegment (  
    IHighlightSegment *pISegment  
);
```

Parameters:

*pISegment*

[in] Pointer to an IHighlightSegment interface to remove.

Return Values:

Returns S\_OK if successful, or an error value otherwise.

## Highlight Segment Interface (IHighlightSegment)

The highlight segment interface 710 enables a user to control a highlighted section of a document. This interface does not provide any methods of its own beyond those available from its parent interface, ISegment.

Description: The highlight segment interface 710 provides type checking for the segments added or moved from the highlighted sections through the IHighlightRenderingServices interface.

Remarks: This interface does not provide any methods of its own beyond those available from its parent interface, ISegment.

## Conclusion

The services described above provide an applications program interface (API) for an extensible editor (MSHTML). The interfaces and the methods associated with each interface are summarized as follows:

- IHTMLEditServices
  - AddDesigner
  - GetSelectionServices
  - MoveToSelectionAnchor
  - MoveToSelectionEnd
  - RemoveDesigner
- IHTMLEditDesigner
  - TranslateAccelerator
  - PreHandleEvent
  - PostHandleEvent
  - PostEditorEventNotify
- ISelectionServices
  - AddElementSegment
  - GetMarkupContainer
  - GetSelectionServicesListener
  - AddSegment
  - RemoveSegment
  - SetSelectionType
- ISelectionServicesListener
  - BeginSelectionUndo
  - EndSelectionUndo
  - GetTypeDetail
  - OnChangeType
  - OnSelectedElementExit
- ISegmentList
  - CreateIterator
  - GetType
  - IsEmpty
- ISegment
- IElementSegment
  - GetElement
  - IsPrimary
  - SetPrimary
- IHighlightRenderingServices
  - AddSegment
  - MoveSegmentToPointers
  - RemoveSegment
- IHighlightSegment



1 The interfaces can be utilized by an extension coupled with the extensible  
2 editor to add new features to the editor, to augment existing features, or to override  
3 the editor's default behavior. Extensions can be used to modify the editor to  
4 provide customized feedback and to present a rich editing experience to a user.

5 Although details of specific implementations and embodiments are  
6 described above, such details are intended to satisfy statutory disclosure  
7 obligations rather than to limit the scope of the following claims. Thus, the  
8 invention as defined by the claims is not limited to the specific features described  
9 above. Rather, the invention is claimed in any of its forms or modifications that  
10 fall within the proper scope of the appended claims, appropriately interpreted in  
11 accordance with the doctrine of equivalents.  
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1        **CLAIMS**

2

3        1.     An electronic document editor, comprising:

4            a default event handler to process editing events;

5            a designer extensibility mechanism to communicate with an extension

6 coupled with the editor, the extension being configured to process at least one of

7 the editing events; and

8            wherein the designer extensibility mechanism provides the editing events to

9 the extension prior to the default event handler processing the editing events.

10

11        2.     The electronic document editor as recited in claim 1, further

12 comprising an extension interface having a pre-handle event method through

13 which the designer extensibility mechanism provides the events to the extension.

14

15        3.     The electronic document editor as recited in claim 1, wherein the

16 designer extensibility mechanism further provides the editing events to the

17 extension after the default event handler processes the editing events.

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1           4. The electronic document editor as recited in claim 3, further  
2 comprising an extension interface having a pre-handle event method and a post-  
3 handle event method, the designer extensibility mechanism providing the editing  
4 events to the extension through the pre-handle event method prior to the default  
5 event handler processing the editing events, and providing the editing events to the  
6 extension through the post-handle event method after the default event handler has  
7 processed the editing events.

8  
9           5. The electronic document editor as recited in claim 1, wherein:  
10           the extension is a first extension; and  
11           the designer extensibility mechanism further provides the editing events to  
12 a second extension after the editing events have been provided to the first  
13 extension, and prior to the default event handler processing the editing events.

14  
15           6. The electronic document editor as recited in claim 5, wherein the  
16 designer extensibility mechanism further provides the editing events to the first  
17 extension and the second extension after the default event handler processes the  
18 editing events.

19  
20           7. The electronic document editor as recited in claim 1, wherein:  
21           the extension is a first extension;  
22           the designer extensibility mechanism further provides the editing events to  
23 a second extension; and  
24  
25

1 the designer extensibility mechanism further provides notice to the first  
2 extension of any action taken on an event by the second extension or the default  
3 event handler.  
4

5 **8.** In an extensible editor having an editor extension coupled therewith,  
6 the editor having an edit designer interface comprising a pre-handle event method,  
7 the pre-handle event method comprising:

8 routing an editing event to the editor extension before the editor acts on the  
9 editing event; and

10 receiving notification from the editor extension indicating whether the  
11 editor should continue to process the editing event after the editing event has been  
12 routed to the editor extension.  
13

14 **9.** The method as recited in claim 8, wherein the routing an editing  
15 event to the editor extension further comprises routing an event identifier to the  
16 editor extension, the event identifier uniquely identifying an editing event.  
17

18 **10.** The method as recited in claim 8, wherein the routing an editing  
19 event to the editor extension further comprises routing an event object interface to  
20 the editor extension, the event object interface providing the editor extension with  
21 means to process the editing event.  
22  
23  
24  
25

1       **11.**     In an extensible editor having an editor extension coupled therewith,  
2 the editor having an edit designer interface comprising a post-handle event  
3 method, the post-handle event method comprising:

4       routing an editing event to the editor extension after the editor acts on the  
5 editing event; and

6       receiving notification from the editor extension indicating whether the  
7 editor should continue to process the editing event after the editing event has been  
8 routed to the editor extension.

9  
10       **12.**     The method as recited in claim 11, wherein the routing an editing  
11 event to the editor extension further comprises routing an event identifier to the  
12 editor extension, the event identifier uniquely identifying an editing event.

13  
14       **13.**     The method as recited in claim 11, wherein the routing an editing  
15 event to the editor extension further comprises routing an event object interface to  
16 the editor extension, the event object interface providing the editor extension with  
17 means to process the editing event.

1       **14.**   A system, comprising:  
2       an extensible editor that processes editing events, the extensible editor  
3       having an event routing controller and a default event handler;  
4       an extension coupled with the extensible editor for processing the editing  
5       events; and  
6       wherein the event routing controller provides an editing event received by  
7       the editor to the extension prior to providing the editing event to be processed by  
8       the default event handler.

9  
10       **15.**   The system as recited in claim 14, wherein:  
11       the extension is a first extension;  
12       the system further comprises a second extension for processing the editing  
13       events; and  
14       the event routing controller provides the editing event to the second  
15       extension prior to providing the event to the default event handler.

16  
17       **16.**   The system as recited in claim 14, wherein the event routing  
18       controller provides the editing event to the extension after the default event  
19       handler has processed the editing event.  
20  
21  
22  
23  
24  
25

1       17.    The system as recited in claim 14, wherein:  
2       the extension is a first extension;  
3       the system further comprises a second extension for processing the editing  
4 events;  
5       the event routing controller routes editing events to the first extension, the  
6 second extension and the default event handler; and  
7       each event is notified of any action taken in response to the editing event by  
8 the other extension or by the default event handler.

9  
10       18.   The system as recited in claim 14, wherein the event routing  
11 controller further provides an event identifier uniquely identifying the editing  
12 event.

13  
14       19.   The system as recited in claim 14, wherein the event routing  
15 controller provides an event object interface to the extension to allow the  
16 extension to access information regarding the editing event.

17  
18       20.   The system as recited in claim 14, wherein the editor further  
19 comprises an edit designer interface that includes a pre-handle event method for  
20 providing the event to the extension prior to the default event handler receiving the  
21 event.

1       **21.**     The system as recited in claim 14, wherein:

2       the editor further comprises an edit designer interface that includes a post-  
3 handle event method for providing the editing event to the extension after the  
4 default event handler has processed the event; and

5       the event routing controller is further configured to provide the editing  
6 event to the extension through the edit designer interface.

7  
8       **22.**     The system as recited in claim 14, wherein:

9       the extension is a first extension;

10      the editor further comprises an edit designer interface that includes a post-  
11 editor event notify method that is called by the event routing controller after the  
12 editing event has been processed by the first extension, a second extension and the  
13 default event handler to provide data to the first extension and the second  
14 extension regarding actions taken in response the editing event.

15  
16      **23.**     A designer attached to an editor, comprising a pre-event handler that  
17 processes an editing event from the editor before the editor processes the event.

18  
19      **24.**     The designer as recited in claim 23, further comprising a post-event  
20 handler that processes the editing event after the editor processes the editing event.

21  
22      **25.**     The designer as recited in claim 23, wherein the pre-event handler  
23 processes the editing event and notifies the editor to prevent further processing on  
24 the event.



1       **26.**    The designer as recited in claim 23, wherein the default event  
2 handler responds to the editing event by notifying the editor to continue processing  
3 the event.

4  
5       **27.**    The designer as recited in claim 23, further comprising a post-event  
6 handler that processes the editing event after the editor processes the editing event,  
7 and notifies the editor to prevent further processing on the event.

8  
9       **28.**    The designer as recited in claim 23, further comprising a post-event  
10 handler that processes the editing event after the editor processes the event, and  
11 notifies the editor to continue processing the editing event.

12  
13       **29.**    An editor that communicates with a first designer and a second  
14 designer, comprising:

15       a default event handler; and

16       an edit designer interface that includes a pre-handle event method to  
17 process an event before the default event handler processes the event, and a post-  
18 handle event method to process the event after the default event handler has  
19 processed the event.

20  
21       **30.**    The editor as recited in claim 29, further comprising a post-editor  
22 event notify method that is called to notify the first extension of an action taken by  
23 the second extension when processing the event.

1           31.    The designer as recited in claim 23, further comprising a translate  
2 accelerator method that translates commands received by the editor.

3  
4           32.    The designer as recited in claim 23, wherein the pre-handle event  
5 method and the post-handle event method include an event ID parameter that  
6 uniquely identifies the event.

7  
8           33.    The designer as recited in claim 23, wherein the pre-handle event  
9 method and the post-handle event method include an event object interface that  
10 allows the extensions to obtain information about the event.

11  
12           34.    An edit designer interface in an extensible editor, comprising:  
13           a pre-handle event method used to send an editing event to a designer  
14 attached to the editor prior to the editor processing the editing event; and  
15           a post-handle event method used to send the editing event to the designer  
16 after the editor has processed the editing event.

17  
18           35.    The edit designer interface as recited in claim 34, wherein:  
19           the designer is a first designer;  
20           the edit designer interface further comprises a post-editor event notify  
21 method used to notify a second designer attached to the editor of an action taken  
22 by the first designer when the first designer processed the editing event.

1       **36.**    The edit designer interface as recited in claim 34, wherein the pre-  
2 handle event method and the post-handle event method include an event ID  
3 parameter that uniquely identifies the editing event.  
4

5       **37.**    The edit designer interface as recited in claim 34, wherein the pre-  
6 handle event method and the post-handle event method include an event object  
7 interface associated with the editing event through which the designer can obtain  
8 information regarding the editing event.  
9

10       **38.**    A method for processing events in an extensible editor that  
11 communicates with a first extension and a second extension, the method  
12 comprising:

13       sending an event to the first extension; and

14       receiving a signal from the first extension indicating whether to continue  
15 processing the event.  
16

17       **39.**    The method as recited in claim 38, further comprising notifying the  
18 second extension about actions taken by the first extension in response to  
19 receiving the event if the signal indicates that the event should not be processed  
20 further.  
21

22       **40.**    The method as recited in claim 38, further comprising processing  
23 the event if the signal indicates that processing should continue.  
24  
25

1       **41.**    The method as recited in claim 38, further comprising sending the  
2 event to the second extension if the signal indicates that processing should  
3 continue.

4  
5       **42.**    The method as recited in claim 38, further comprising:  
6       determining if the event is a command; and  
7       if the event is a command, translating the command and withholding the  
8 event from the extensions.

9  
10       **43.**   The method as recited in claim 38, further comprising:  
11       determining if the event is a command; and  
12       if the event is a command, translating the command and notifying the  
13 extensions that the command has been processed.

14  
15       **44.**   A computer-readable medium having computer-executable  
16 instructions that, when executed on a computer, perform the following steps:  
17       detect an editing event;  
18       routing the editing event to a designer;  
19       receiving a response from the designer that indicates whether the editing  
20 event was consumed by the first designer.

21  
22       **45.**   The computer-readable medium as recited in claim 44, further  
23 comprising computer-executable instructions to perform the following step:  
24       processing the editing event if the response from the designer indicates that  
25 the editing event was not consumed by the first designer.

1  
2       **46.**   The computer-readable medium as recited in claim 44, wherein the  
3 designer is a first designer, and further comprising computer-executable  
4 instructions to perform the following step:

5       notifying a second designer that the first designer consumed the event if the  
6 response from the first designer indicates that the first designer consumed the  
7 event.

8  
9       **47.**   The computer-readable medium as recited in claim 44, wherein the  
10 designer is a first designer, and further comprising computer-executable  
11 instructions to perform the following step:

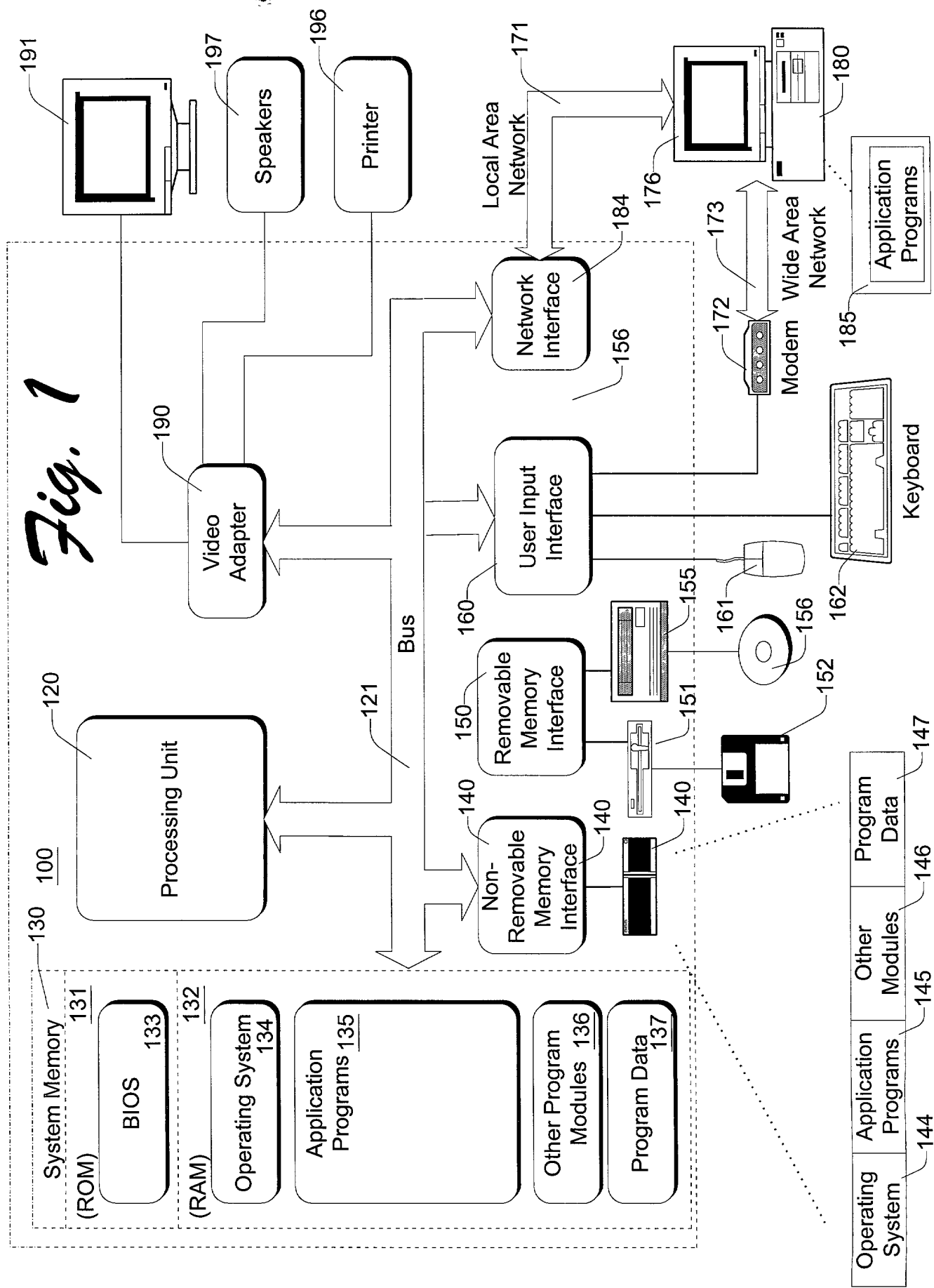
12       routing the event to the second designer if the response from the first  
13 designer indicates that the first designer did not consume the event.  
14  
15  
16  
17  
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25

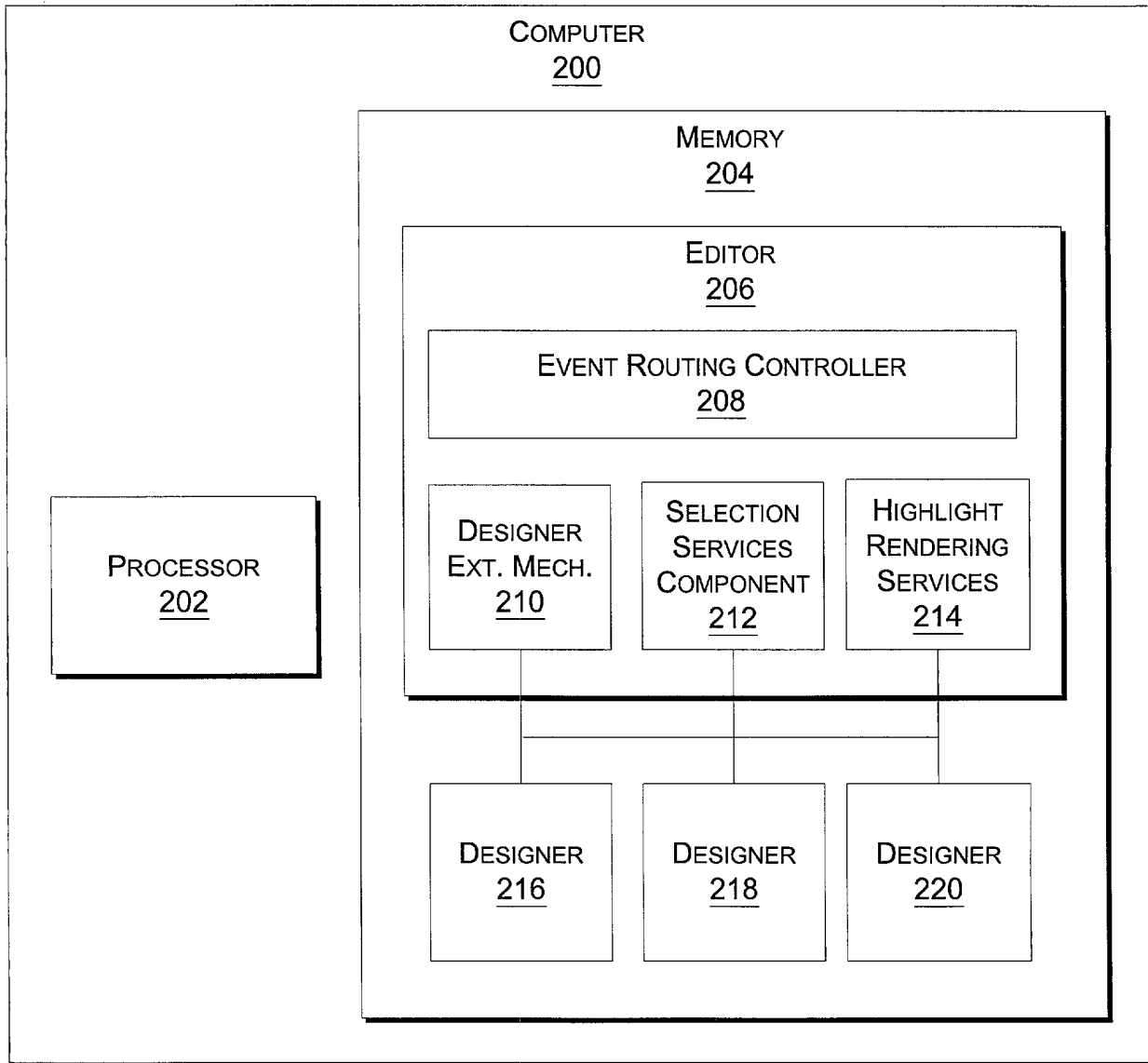
## ABSTRACT

An extensible editor allows integration of extensions that modify the editor's default behavior and provide customized feedback to users. The editor includes an event routing model that works to decrease the occurrence of conflicts between the editor and extensions and between extensions. Upon the occurrence of an event, the editor routes the event to each extension before the editor's default handling of the event occurs. When an extension responds to an event, the extension may "consume" the event by indicating to the editor not to allow further processing of the event. After an event has been pre-processed by each extension, the default editor acts on the event. The editor then routes the event to each extension again, to allow each extension to process the event after the default editor has acted. When the post-processing is completed, each extension is notified of the actions taken by the editor and by each of the other extensions.

The editor includes interfaces through which extensions are connected to the editor and through which selection services and highlight rendering services are provided. The selection services interfaces provide a clear separation of a logical selection position in the document and the visual feedback provided for the selection, allowing extensions to be designed that provide customized selection feedback. The highlight rendering services interfaces provide an extension with the ability to augment an existing selection without modifying the actual document.

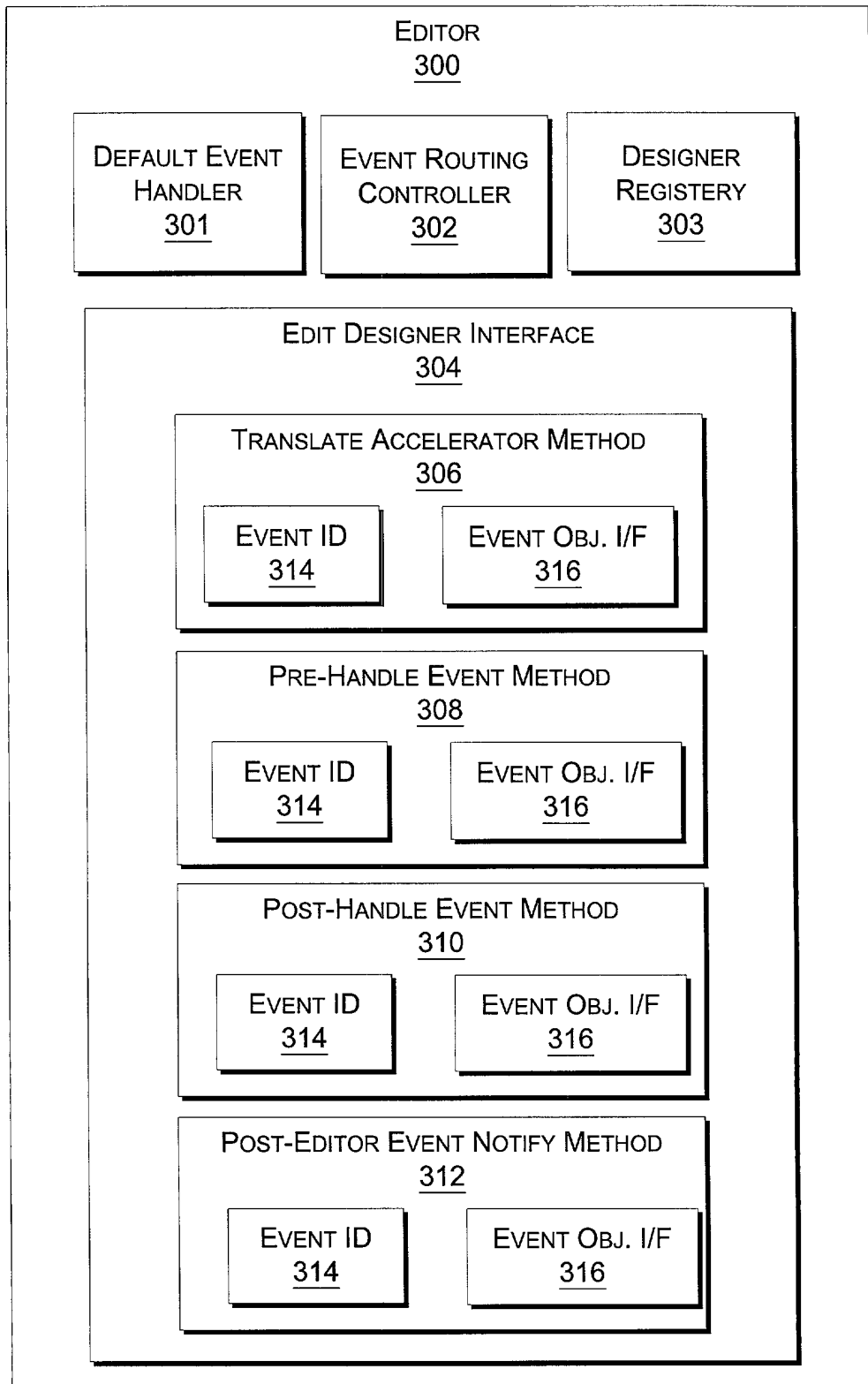
**Fig. 1**





*Fig. 2*





*Fig. 3*

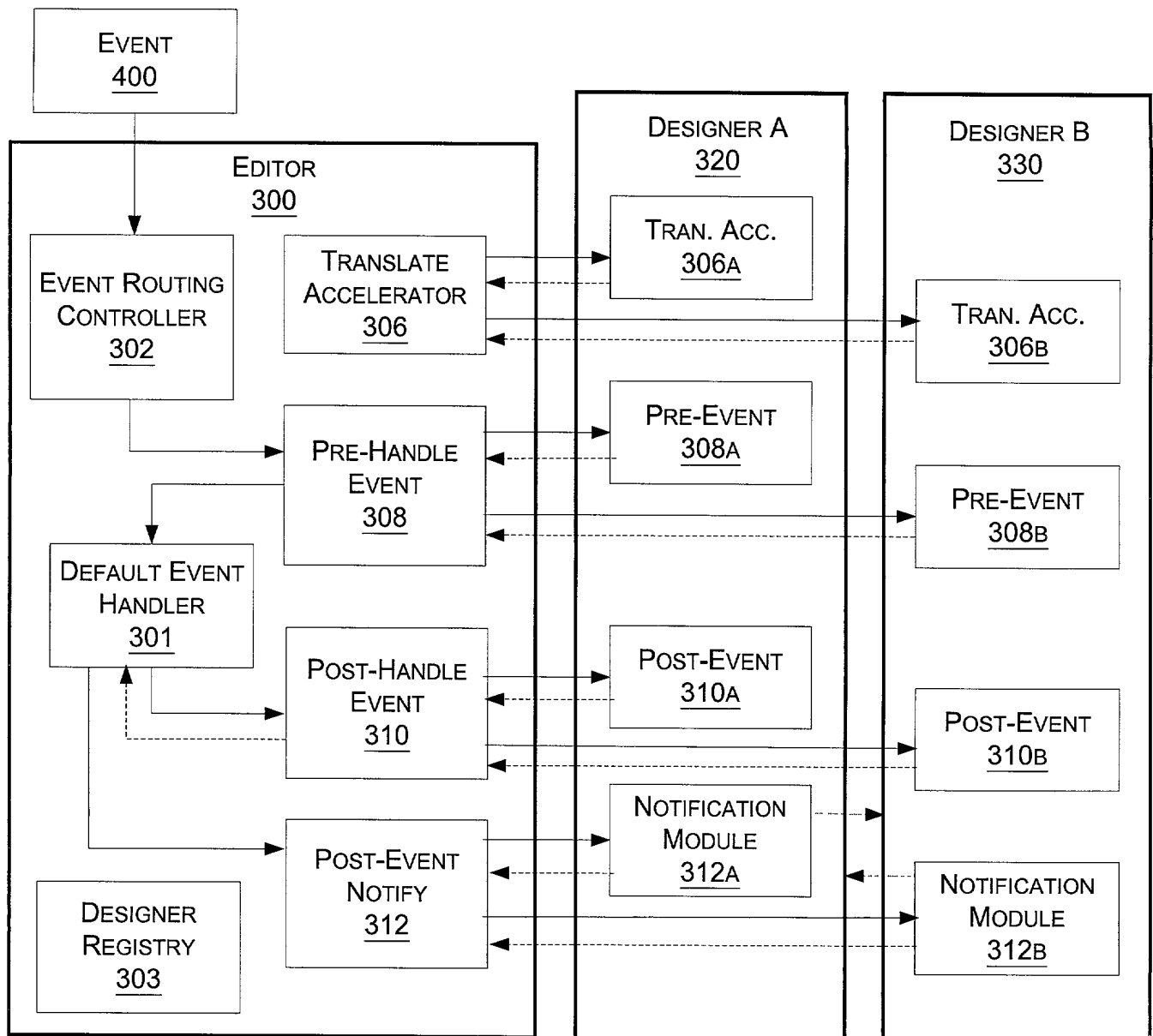
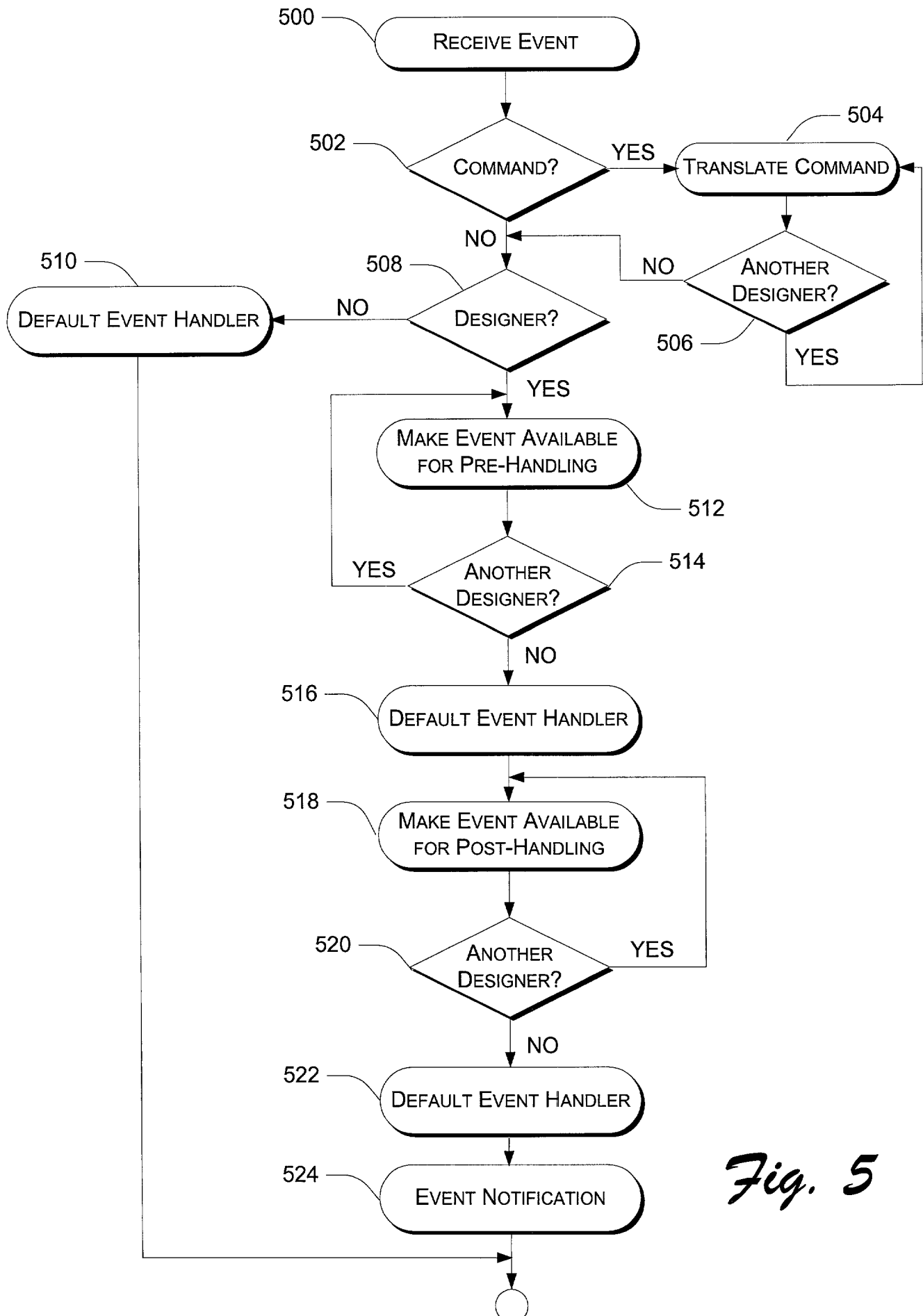


Fig. 4



*Fig. 5*

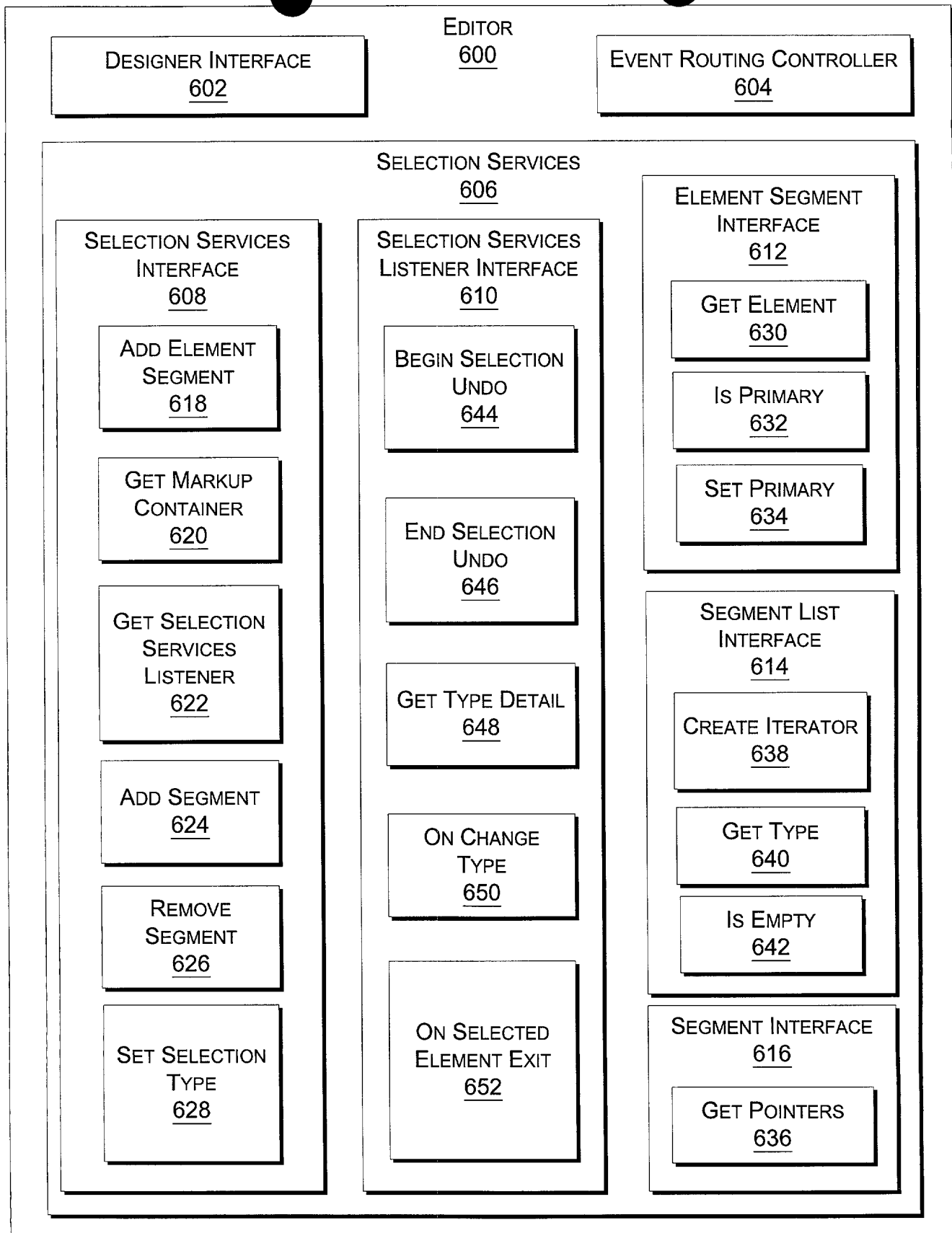
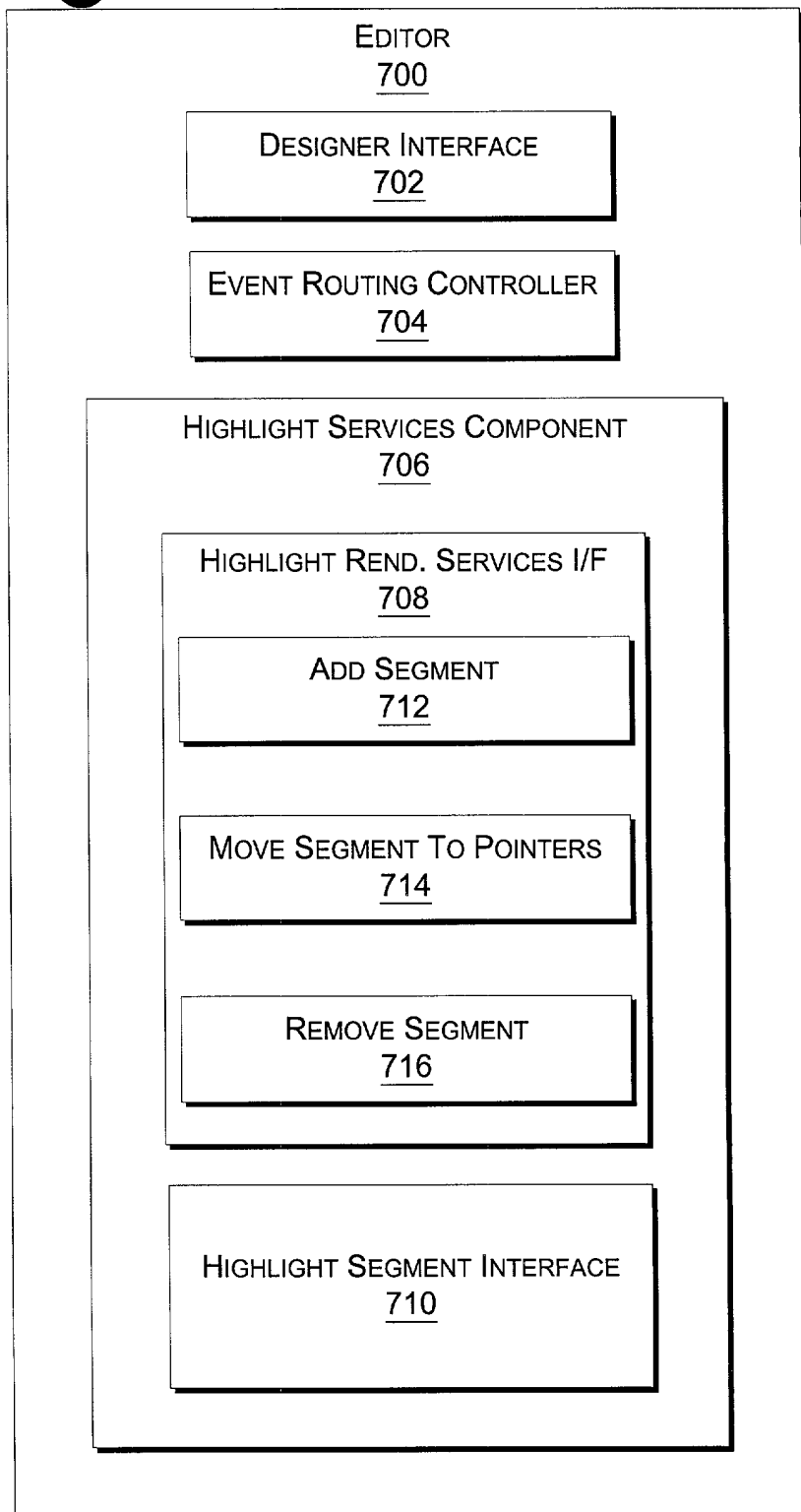


Fig. 6



*Fig. 7*